A PYRRHOCORID BUG CAPABLE OF BITING MAN

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So far as I am aware, the following notes contain the first record of the fact that a bug of the family *Pyrrhocoridae* has been found to bite man. The observation was made at Freetown, Sierra Leone, but so near to the time of my departure that little opportunity of carrying out experimental work on the subject was available.

The natural order Rhynchota or Hemiptera is divided into the sub-orders Heteroptera and Homoptera; the Heteroptera into Gymnocerata and Cryptocerata; the Gymnocerata into several families, of which the family Pyrrhocoridae is one; in a sub-family of this—the Pyrrhocorinae—occur many genera, to one of which, namely, Dysdercus, belongs the insect with which I am here dealing. Mr. Lang, of the British Museum, has kindly identified the species for me as *D. superstitiosus*, F.

Dysdercus superstitiosus was observed by me at Freetown, in 1921, specimens being found even indoors in the laboratory. At that time I made a few experiments in order to see if the insects would bite; the bugs were placed singly in wide test-tubes and applied to the arm, but they showed no inclination to bite or even stay on the skin, making, on the contrary, efforts to escape by climbing up the test-tubes; it was concluded, rather prematurely as it now appears, that they were entirely non-biting in so far as human beings are concerned. They were observed in numbers on the ground, especially in the vicinity of a silk cotton tree, *Eriodendron anfractuosum*, situated about a hundred yards from the laboratory. It was observed that they appear to see very well, as they are extremely sensitive to any movement made in their vicinity; also that they make off instantly and move away with

great rapidity when disturbed. This year, in April, the silk cotton tree pods were opening on the tree and it happened that on one or two days the wind drove the cotton along, in the direction of the ground on which the laboratory stands. In the flocculi of silk cotton which were wafted on to the ground were seen numerous small red bugs, which in most cases extricated themselves quickly and ran about actively. Occasionally a silk cotton seed was carried along with the floating fragments of fibre, and it was not unusual to see on the ground a seed covered with bugs, some of them with their beaks inserted into it and others trying to pierce it, the seed being pulled in all directions during the process. When the bugs grew larger some were observed to develop cannibal habits, more especially when placed together in test-tubes with no food.

On the 24th of April, 1923, while sitting out in front of the laboratory just after sunset I experienced a sharp bite on the front of the ankle. On looking to see what was biting I moved slightly and could observe no mosquito or other biting insect, but saw a red bug moving rapidly off my sock. It was not possible to be sure that the definitely painful bite was caused by the bug; the reaction was a small itching swelling which had disappeared in twenty-four hours. Two days later, on the 26th April, at the same place and time, a bite was again felt on the same ankle. Leaning forward carefully I saw a red bug biting busily through my thick black sock. The bug's body, as its beak went deeper and deeper into the skin, assumed an attitude which was nearly vertical; considerable irritation was felt at intervals during the time the biting was going on. The process was timed and had lasted nearly four minutes when the bug was disturbed by a large black ant, which, in passing rapidly across the ankle, collided with the bug. The latter instantly made off and was escaping when it was captured in a test-tube which had been kept at hand since the previous observation, so as to be ready should the opportunity arise again. The reaction was on this occasion also only local, but was much more definite. Itching and irritation were felt, and in an hour's time a circular swelling of the size of a sixpenny piece had developed, well raised in the centre. This remained and in two days was rather hard, but it went away gradually in about five days from the time of the bite. The bug was examined and found to be a last larval stage:

the dissection of it did not reveal the presence of blood in the alimentary canal, nor were flagellates found; but the dissection had to be carried out with the light of an oil lamp, which was unsatisfactory.

Laboratory experiments. Several experiments were carried out by placing single bugs in large test-tubes on the human skin, but in no case was biting observed, the bugs being only anxious to escape by climbing up the tubes. Too much stress should not be laid upon the negative results of these experiments, in view of the fact that bugs which had been seen attacking the seed of the silk cotton tree on the ground made no attempt to attack the seeds when placed with them in tubes similar to those used for the skin experiments. Ballou (1906) made a comparable observation. He says: 'Although the cotton stainers are known to feed on the ripe cotton seed about the gin-houses, they would not do this in the laboratory, nor would they feed on the seeds of the silk cotton.' It is probable that on account of the timidity of the bug, special methods of experimentation in the laboratory must be devised.

Success, however, attended an experiment which was carried out in England. Two bugs were placed in the toe of a black sock, which was then drawn half on to the foot. After some minutes a bite was felt on the dorsum of the foot, but in the attempt carefully to remove the sock the bug was disturbed and ceased biting; the reaction was an itching sensation with subsequent local swelling, and for a few days a red circular area on the dorsum of the foot was observed. Later the whole leg became swollen and oedematous, and intense itching occurred; there was no pain, however, and no enlargement of glands and no temperature. Parasites were not found in the blood, but there was eosinophilia reaching 50 per cent. In three weeks the swelling began to go down, and in a month was gone.

The bionomics of Dysdercus. This genus of bugs is best known from its association with cotton in most parts of the world, and it contains the majority of insects classed as cotton stainers. Maxwell-Lefroy gives a detailed account of the morphology and bionomics of *D. cingulatus* which occurs in India, as well as notes on other species; Ballou (1906) enumerates a large number of species which are found in the West Indies, with observations on the various stages

of the life-history in different species. Egg-laying commences within a few days after copulation is over, the eggs being laid to the number of up to a hundred in various sites, on the ground, under leaves, in the open bolls; Peacock, in *D. superstitiosus* in captivity, found egg clusters from twenty to one hundred and twenty; the egg-stage lasts about a week, and the larva which emerges undergoes during its growth five ecdyses. The adult is distinguished from the larva in most cases, according to Butler (1923), by the acquisition of wings; increase of number of joints in tarsi, and sometimes in antennae; transference of openings of scent glands from dorsal to ventral side; full development of sexual organs. The time taken for growth from the time the egg is laid till the adult bug stage is reached is forty-nine to eighty-six days for *D. cingulatus*, in India.

Food Plants. The chief food plants of these bugs are the following:—The cotton *Gossypium* sp.; the silk cotton, *Eriodendron anfractuosum*; the Okra or Bhindi, *Hibiscus esculentus*; the musk mallow, *Hibiscus abelmoschus*, and other plants of the Malvaceae.

Other food. Dysdercus superstitiosus was observed by me at Freetown feeding in large clusters on the carcase of a frog. Mansfield-Aders (1919-20), in his account of insects injurious to economic crops in the Protectorate of Zanzibar, states that he has on many occasions seen *Dysdercus fasciatus* feeding with avidity on fresh mammalian carcases, skins, and skulls. Of *D. superstitiosus* in Zanzibar, he says that it is by no means a common species on cotton, but that the silk cotton is commonly attacked by it.

Lamborn (1914-15) says of Southern Nigeria, 'During the dry season the Pyrrhocorid bug, *Dysdercus superstitiosus*, F., was found in some numbers . . . . and at this time they appeared to be able to thrive on almost any food, whether of animal or vegetable origin, for eight or ten were noticed feeding on a dead and sun-dried lizard and a batch of young nymphs was found on sheeps' excreta.'

Peacock (1913-14) gives a coloured plate of the stages of *D. superstitiosus*. He records the observation which he made of a number of young stainers about three weeks old sucking a dead snail.

Seasonal occurrence. Lefroy gives the following account of the

sequence of breeding and feeding habits of *D. cingulatus* at Pusa :—

April-May—Extensive breeding on Simul (silk cotton).
June-July—Feeding miscellaneous Bhindi, Hibiscus, etc.
August-November—Breeding in cotton.

'In most parts of India breeding is of necessity confined either to the cotton season, to the season when Bhindi is in pod, or to the season when the Simul is in bearing.' These observations are of interest with regard to the effect of season and the presence of particular food plants on the numbers and vitality of a single species.

Distribution of Species. Of equal interest are the observations made by Ballou on the distribution of different species in the West Indies. One species may extend for a distance and then, apparently without any change of environment, stop and give place to a different species. This sudden demarcation of the limits of a species is most noticeable in the case of *D. ruficollis*, and it is stated 'in many instances only one locality is known for each species, and most of the others occur only in a few adjoining countries or islands.' The distributions of *D. andreae* and *D. delauneyi* give good examples of localization. It is noted by Lefroy that *D. evanescens*, Dist., is recorded from Sikkim, the Khasi and Garo hills, Burma, from the Bor Ghat, Bombay, also from Chapra.

Modification of feeding habits. Butler (1923) considers the possibility of rapid change of food habit among bugs. He refers to two species of Capsidae which are even now gradually establishing, or indeed have established, themselves in orchards, viz., *Plesiocoris rugicollis* and *Orthotylus marginalis*; the natural food plants of these insects are various species of *Salix*, 'and the attack upon orchards indicates a startling change of taste brought about by the temptation of well-nurtured plantations of apple trees in their neighbourhood.' In captivity Ballou fed stainers on cotton seed, portions of unripe cotton bolls, bits of sugar cane and pieces of banana.

Duration of Life. In the insectary *D. cingulatus* was kept by Lefroy for four months; life was long when conditions were not favourable, *i.e.*, little food. I may observe here that a few specimens of *D. superstitiosus*, last larval instar and adult, which received no

food and which were kept at ordinary temperature, survived the voyage from Sierra Leone to England and lived for a week after arrival.

Bacterial parasites of Dysdercus spp. De Charmoy (1921) says that in Mauritius *Dysdercus* is known to transmit several bacterial diseases, and that it is the vector of an internal disease of the bolls similar to that described by Nowell and others in the West Indies.

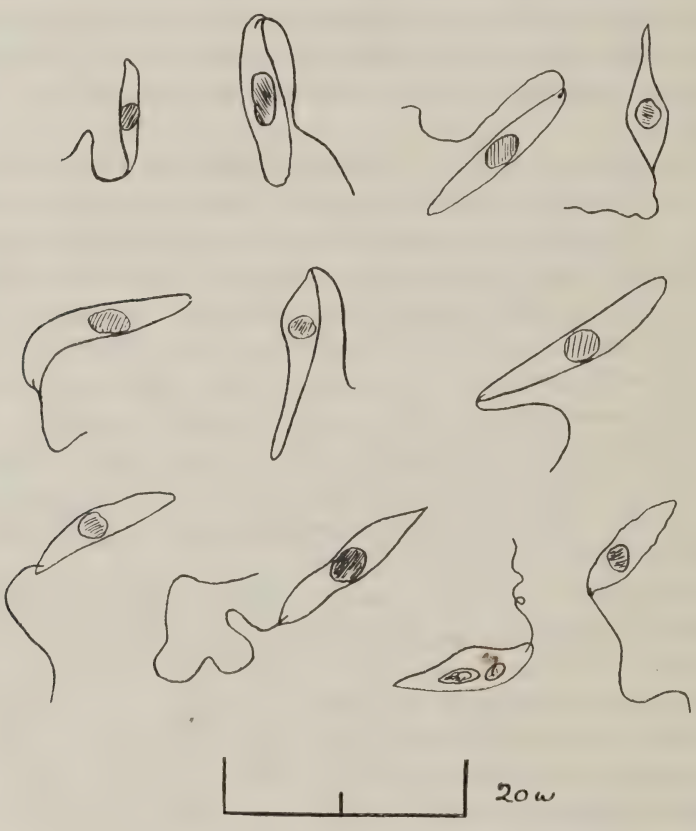

Fig. 1. Flagellate parasite of *Dysdercus superstitiosus*, F.

Flagellate parasite of Dysdercus superstitiosus, F. The bugs were found by me to be infected with a herpetomonas; it was present in various portions of the alimentary canal, and was recovered once from the coelomic fluid by cutting off the antenna near its base and examining the fluid which exuded; it was not found in the salivary glands, but as will be seen from the table subjoined, the number of dissections was limited:—

Flagellates (Herpetomonas) present in *Dysdercus superstitiosus* F.

Dissected	Infected	Rectum	Hind gut	Mid gut	Salivary glands	Coelomic Fluid
14	9	4	7	2	0	1

The occurrence of flagellates in Hemiptera-Heteroptera is well known. Patton and Cragg (1913) refer to the fact that tea, coffee and garden produce of all kinds are attacked by various species of bugs. They mention the family Lygaeidae, of which several species are infected with flagellates; *Oxycarenus laetus*, which is common on the cotton plant in Madras, is nearly always infected with a species of Herpetomonas; *Lygaeus pandarus* (*militaris*), which is common on the milk plant, *Calotropis gigantea*, is also infected with a flagellate of the same kind, *Herpetomonas lygaei*, which very closely resembles the parasite of Kala azar; *Lygaeus hospes* is infected with the same parasite. Of *H. lygaei*, Patton, the authors say that it is indistinguishable in its pre- and post-flagellate stages from the parasite of Kala azar as seen in man. The observations made by me on the flagellates of *Dysdercus superstitiosus* bear out these statements as regards the appearance of the Herpetomonas found, in the flagellate stage.

It is of interest to recall the discovery by Lafont (1909) of *Herpetomonas davidi* in the latex of *Euphorbia pilulifera* and to the presence of this flagellate in a species of Nysius. Miss Robertson has recorded a herpetomonas from the alimentary tract of *Dysdercus casiatus*, the red cotton bug of Uganda; only a few infected specimens were examined. A still more important observation of Miss Robertson is in connection with the species *Leptoglossus membranaceus*, of the family Coreidae in Uganda; she found in its alimentary tract a herpetomonas; the parasite was found very frequently to invade the salivary glands. Miss Robertson considers notable ' the independent development in a sucking insect of all the factors requisite for the transmission of a flagellate, parasitic in the intestine by way of the mouth-parts of the insect host.'

The significance of the observation which I have made on the biting capability of *Dysdercus superstitiosus*, F., is evident from a

consideration of the foregoing facts. The work of Laveran and Franchini (1913) and of Fantham and Porter (1915) went to prove that insect herpetomonas may, when injected into animals, produce effects analogous to those occurring in Kala azar, the flagellates resembling cultural forms of *Leishmania donovani*, giving rise to the non-flagellated rounded forms. The partial development in the bed bug obtained by Patton of Kala azar parasites by feeding experiments is important, and especially so in view of the non-success which has hitherto attended all attempts to find an insect vector of the parasite of this disease.

Roubaud and Franchini (1922) obtained in mice infection with Leishmania forms of parasite by allowing fleas having a natural infection to breed in their box. The infection, which proves fatal to the mice, was conveyed to fresh mice by means of subcutaneous injection of ground-up tissues. These workers also obtained a similar result in mice by injecting into them the faeces of fleas.

Although there is, as yet, no evidence that *Dysdercus superstitiosus*, F., is capable of removing blood from man, there is ample evidence that in biting it is capable of injecting an irritating substance under the skin. This irritating substance can on analogy be none other than the salivary fluid; it is clear, therefore, that all the conditions for transference of a parasite to man are provided if salivary infection is present. Dr. P. A. Maplestone reports that he has found infection of the salivary glands.

There is a hypothesis put forward by Stephens (1915) to explain the lack of success of infecting arthropods from Kala azar cases. On this hypothesis—the hemi-cyclic hypothesis—it is possible that a biting arthropod may infect man by its bite; the parasite injected into man grows and multiplies in the tissues but does not enter the peripheral blood in sufficient numbers to cause an infection in the alimentary tract of a fresh arthropod when biting; this is tantamount to saying that the parasite which gets into the arthropod from some other source than man reaches in man a *cul de sac* from which it cannot escape. The hemi-cyclic hypothesis, however capable it might be of explaining transmission of disease by the bites of insects which were yet not capable of sucking blood, need hardly be considered here, as we do not know what are the actual capabilities of such bugs in general in this respect.

It may be noted that whereas Kala azar has a very limited distribution, the bed bug, in which early development has been observed, is world wide in its range. If an insect transmitter of Kala azar is to be found, it is probable that it will be more restricted in its distribution than is Cimex. Their localized distribution, their seasonal dependence on certain forms of plant food and their evident adaptability, point to bugs of the Pyrrhocoridae and similar families as objects of study. I believe my observations and experiments indicate the necessity for an exhaustive investigation of all such forms, not only in countries where Kala azar abounds but also in countries in which Tropical Sore occurs.

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